



Gujarat Solar Rooftop program

Sharing experience on structuring an innovative Solar PPP Project



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ESMAP Training, Pattaya, April 2014

Structure

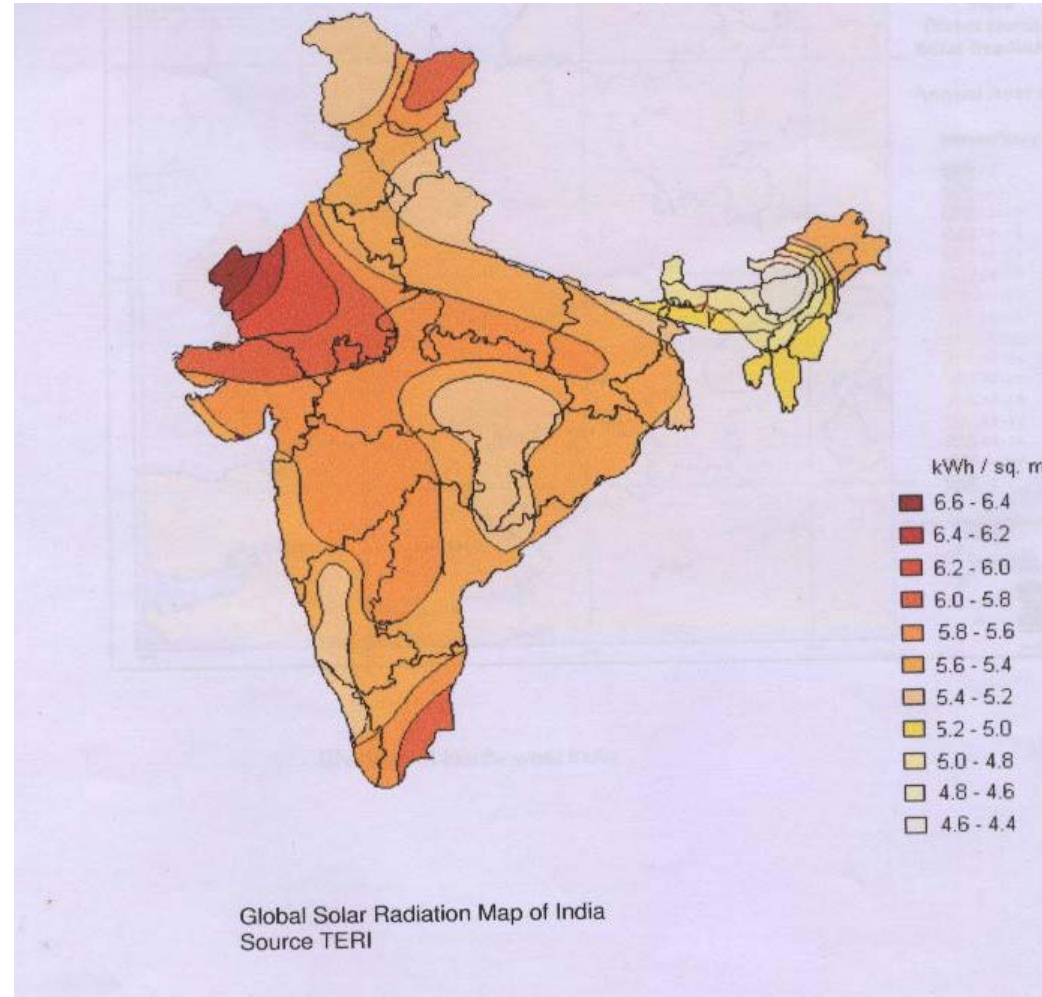
- The Business Case
- Background & Context
- Business Model/Transaction Structure
- Key activities & Current project Status
- Key learnings
- Initiatives on replication

Potential for Solar Power

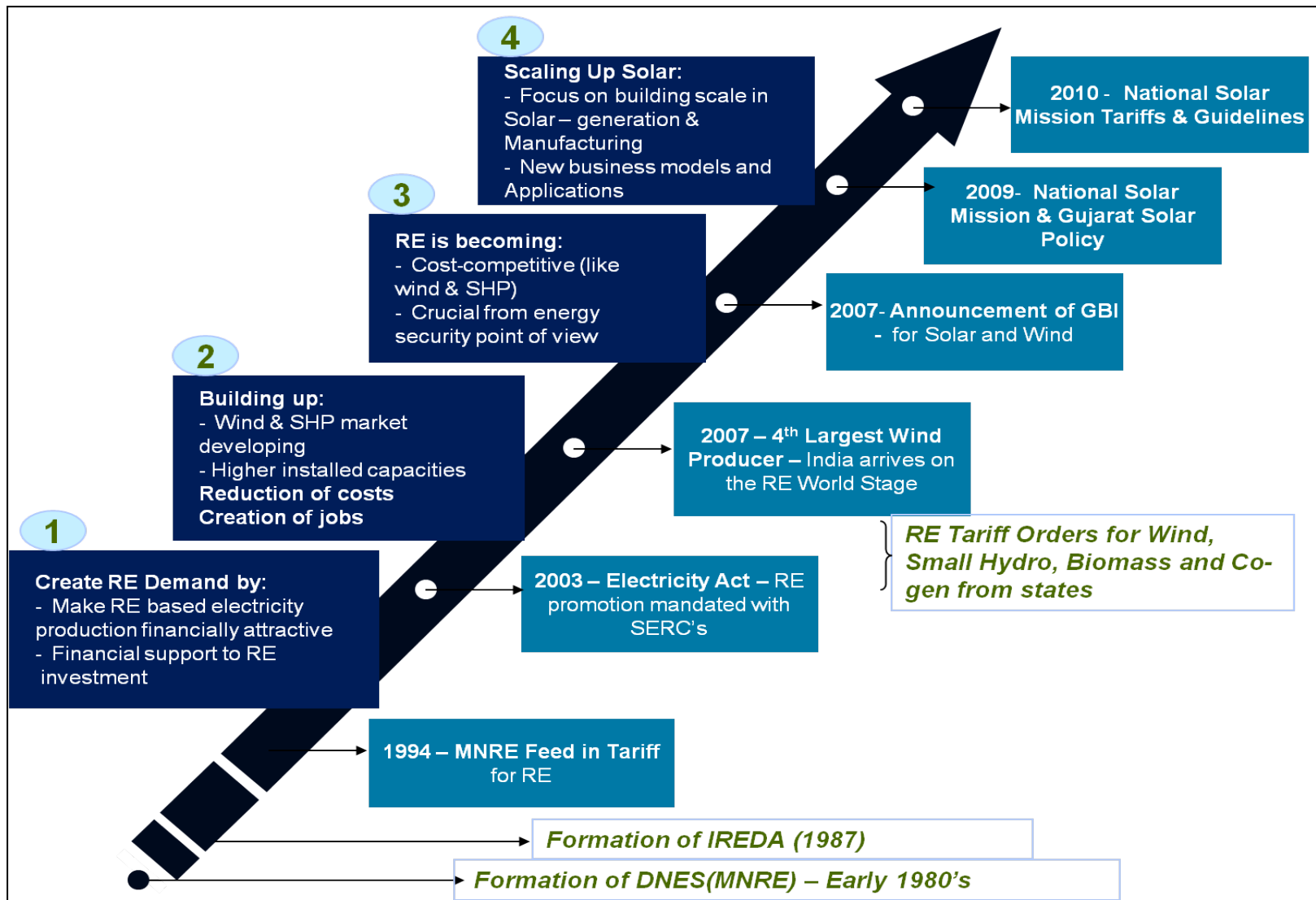
There are 280 clear sunny days in most parts of the country. Most parts of the country receive solar radiation sufficient enough to effectively utilize solar energy systems

Gujarat gets 5.5 to 6.0 kWh/Sq.m/day which equates to 330 sunny days / year

.....solar power can be used to meet energy requirements for centralized as well as decentralized



Key Developments for Renewable Energy



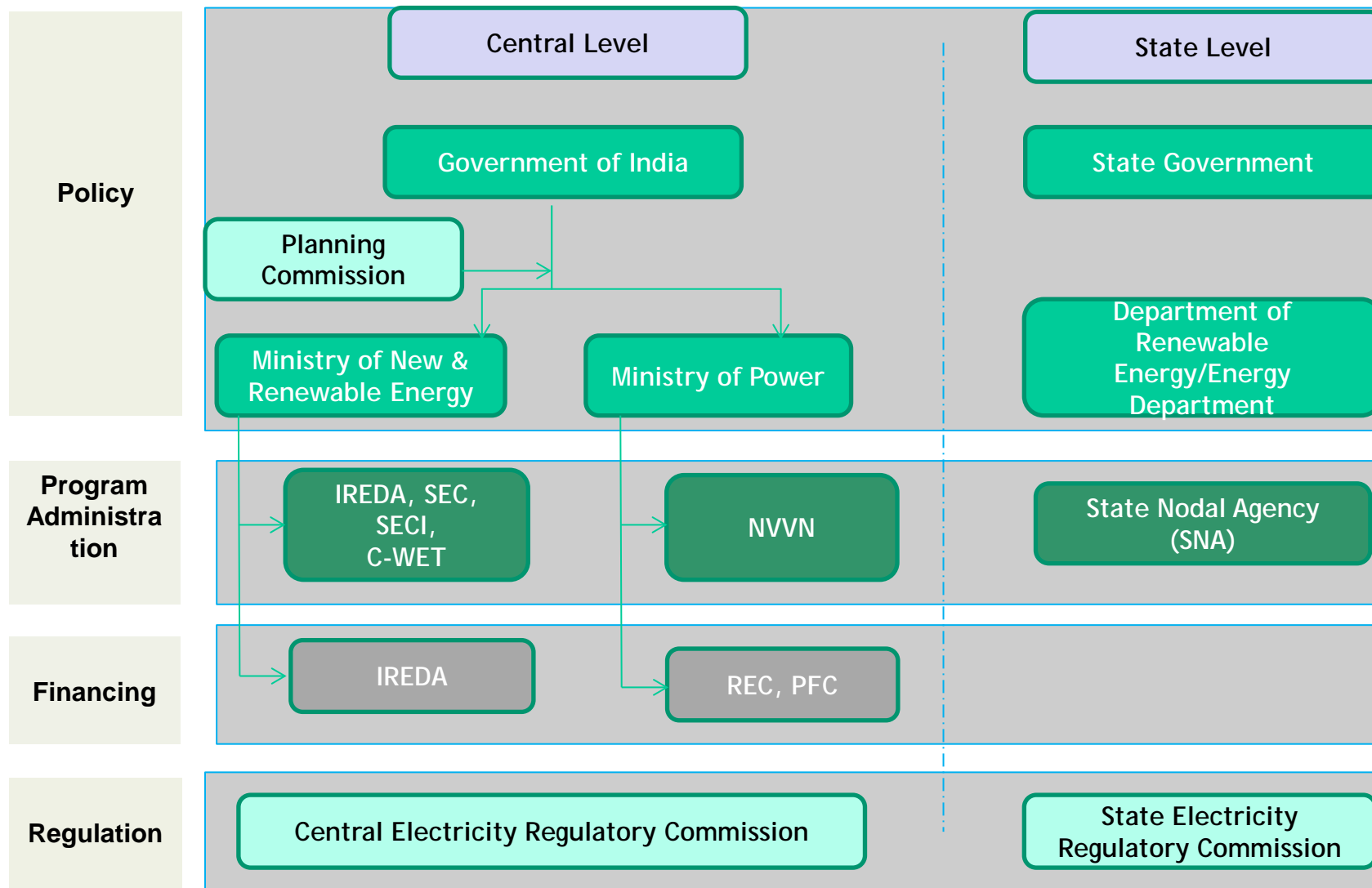
Jawaharlal Nehru National Solar Mission: Key Highlights

Objective of the National Solar Mission

- To achieve volume production at a scale which leads to cost reduction and rapid diffusion and deployment of solar technologies across the country (including rooftop)

S. No	Application Segment	Total Targeted Achievement for Phase 1 (2010-13)	Total Targeted Achievement for Phase 2 (2013-17)	Total Targeted Achievement for Phase 3 (2017-22)
1	Solar Collectors	7 Million Sq meters	8 Million Sq meters	5 Million Sq meters
2	Off Grid Solar applications	200 MW	800 MW	1000 MW
3	Utility grid power, including roof top	1100 MW	4000 MW	20000 MW

Current Institutional Structure - Solar Energy



The Concept

The Concept

- Every building whether home, industry, institution, commercial establishment can generate some solar power by installing PV panels on rooftop

Key Benefits

- Promoting distributed power generation
- Savings in transmission and distribution losses and Savings in developing / Upgrading transmission infrastructure
- Ability to leverage a larger retail investor base and self-replicate
- Ease of development (permitting, siting & clearances)
- Creation of value from under-utilized rooftops



Project Background

Client Need

- The Government wanted to demonstrate technical, commercial and regulatory viability and sustainability of rooftop solar projects.
- They wanted to get grant money to subsidize the capital cost of the project
- A Grid Connected Photovoltaic Rooftop Program to mark the first distributed power generation programme in India in its true sense - ***"Kilowatt-programme at a megawatt-scale"***

The Solution

- IFC along with the GoG created a solution wherein both envisaged the implementation of a 5 MW distributed/grid connected rooftop solar project in Gandhinagar, Gujarat through a PPP model

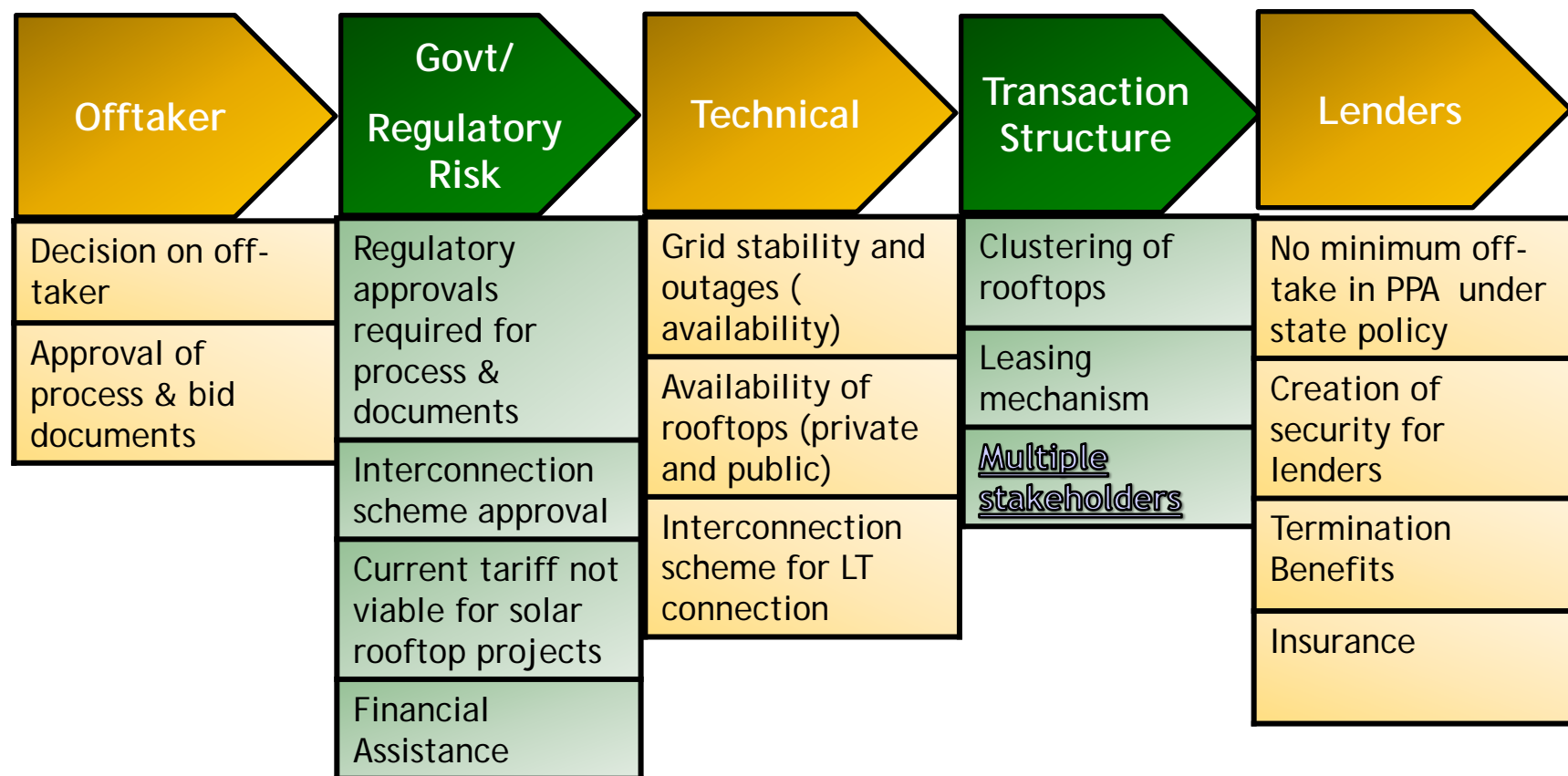
Expected Impact

- Project would reduce ~ 7,154 tons of CO2 equivalent annually with an investment of US\$10-12 M
- Potential for replication in Gujarat and beyond

Chain of Events



Key Project Risks



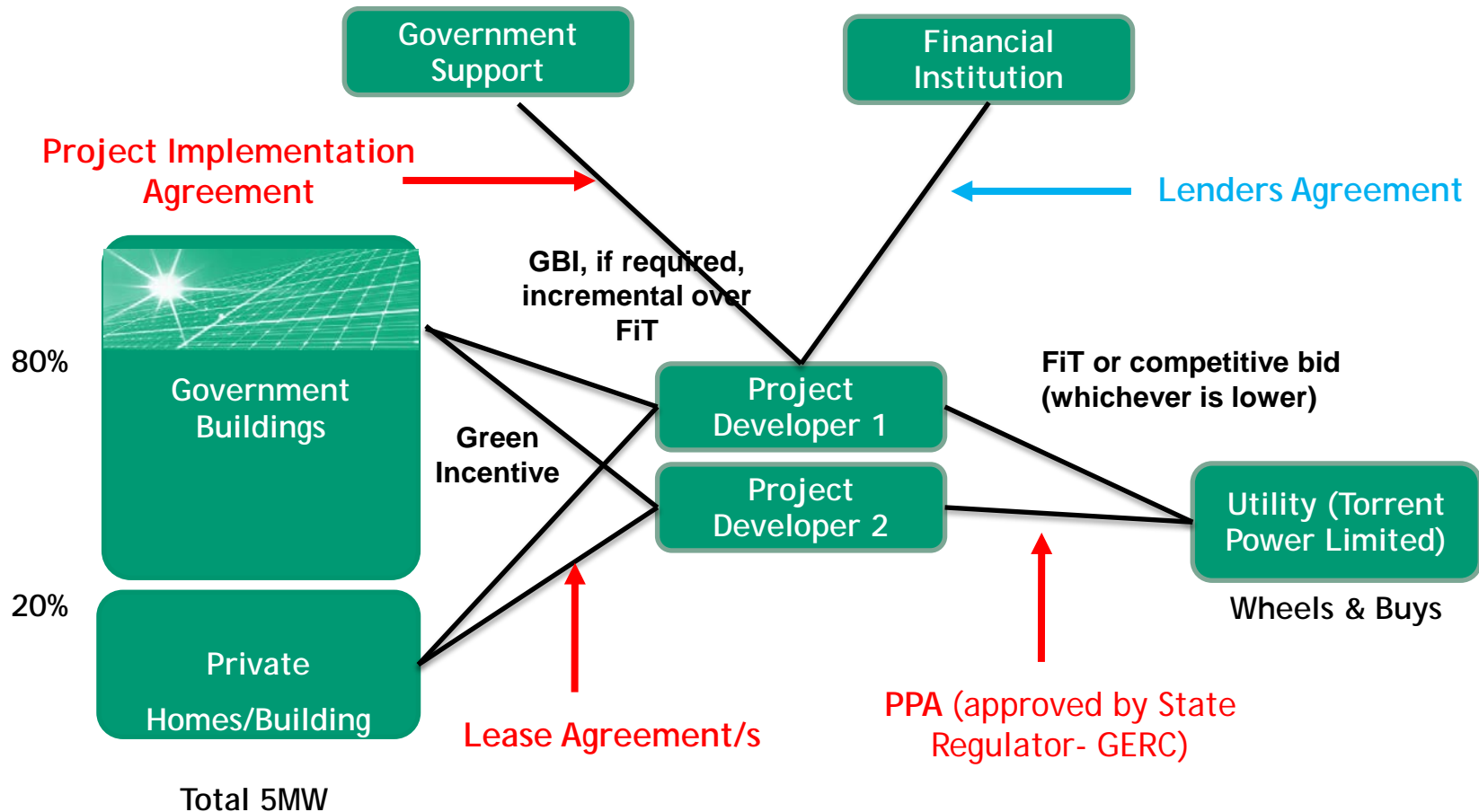
Detailed Feasibility undertaken and Project Documents prepared based on analyzing the above identified risks and extensive consultations with stakeholders

Key Activities Undertaken

- Detailed Project Due-diligence (technical, commercial, legal & regulatory)
- Identification and survey of roof areas (80 % roofs on Govt buildings, 20 % residential roofs - bidder's responsibility)
- Financial analysis and Project Structuring
- Stakeholder consultations / Convening - Government, Bidders, Regulator, Rooftop owners, utility (off taker)
- Visits to potential roof accompanied by GoG & oftaker
- Analysis and mitigation of various risks,
 - Off taker, Technical, regulatory, Commercial etc
- Finalization of Transaction Structure & Bid Documents
- Buy in from Regulator (Gujarat Electricity Regulatory Commission) for the bid process and the PPA (Power Purchase Agreement)
- Bid Process Management

Supported by consultants: Deloitte(technical/commercial) & CMS/HSA(legal)

Business Model: Gandhinagar Pilot Project



Tariff Implication - Government Perspective

- Azure Sun Energy Pvt. Ltd. ("Azure")
- Ananth Solar Power Maharashtra Pvt. Ltd. (SPV OF "SunEdison")

	Azure	SunEdison
Quoted Tariff	Rs. 11.21 /kWh	Rs. 11.793 /kWh
GERC relevant tariff	Rs. 11.14 /kWh (availing AD)	Rs. 12.44 /kWh (without AD)
Torrent pays:	Rs. 11.21 /kWh	Rs. 11.793 /kWh
GoG-PIA (GPCL) Pays Torrent:	Rs. 0.07 /kWh	---

- Liabilities to GoG/GPCL :- Rs.0.07/kWh Generation of Rooftop Solar capacity (Max. up to 2.5 MW) generation
- Revenue to Govt. Buildings :- Rs. 3 Per KWh (For 4 MW) Generation of Rooftop Solar capacity installed.

Program Status (Azure, Inst Buildings)

Sr.	Name of Building	(Kw)	Status
1	Jivaraj Mehta (total 20 Blocks)	1454.5	Commissioned
2	Nirman Bhavan -Sec-10	39.2	Commissioned
3	Patnagar Yogana Bhavan Block I	50.40	Commissioned
4	Patnagar Yogana Bhavan II	90.72	Commissioned
5	Patnagar Yogana Bhavan III	40.32	Commissioned
6	New Collector Office- Sec-11	61.32	Commissioned
7	SP Office-Sec-27- Block -1	56.56	Commissioned
8	SP Office-Sec-27-Block-2	59.64	Commissioned
9	Primary School- Sec-12	29.68	Commissioned
10	Court Building -Sec-11	50.4	Commissioned
11	Udhyog Bhavan -Sector-11	68.88	Commissioned
	Total Capacity Commissioned	2001	

Program Status (sun edison, Inst Buildings)

Sr.	Name of Building	(Kw)	Status
1	Govt. Engineering College	363.60	Commissioned
2	HSS-16	64.80	Commissioned
3	STC	43.20	Commissioned
4	ITI	237.60	Commissioned
5	GEER	43.20	Commissioned
6	Govt. Polytechnic college	169.50	Commissioned
7	Government Science College	99.99	Commissioned
8	Gymkhana	99.74	Commissioned
9	GERI	61.95	Commissioned
10	Government Hostel	20.40	Commissioned
11	SWDC	58.56	Commissioned
12	HSS 27	61.80	Commissioned
13	ARL	98.40	Commissioned
14	Commerce College	60.48	Commissioned
15	GHSS- Sector 20	60.48	Commissioned
16	Govt Arts College	80.64	Commissioned
17	Lokayukta	60.48	Commissioned

5-MW Grid Connected “Gandhinagar Solar Rooftop Project” - Program status April 2014)

Name of Developers	Commissioned (Govt.)	Remarks
Azure Power	2000Kw	
SunEdison	1684.86Kw	Reduced capacity
Total Commissioned	3684.86 Kw out of 4000 Kw (Say 3.7 Mw)	

Residential Category

Name of Developers	Commissioned	Remarks
Azure Power Ltd.	500 Kw (163 residences)	1000 Kw Commissioned
SunEdison	500Kw (113 residences)	
Total commissioned capacity Govt. and well residential category		
Total installed & commissioned	4.7 Mw out of 5-Mw	

Installations (residential) under 5 MW Gandhinagar Program & GPCL Outreach Centre



Installations under 5 MW Gandhinagar Programme



264.04 kW @ Jivraj Mehta Bhavan Nos. 1, 2 and 4, Sector 10-b



**60.48 kW @ Lokayukta,
Sector 10**

**80.61 kW @ Govt. Arts College,
Sector 15**

**80.61 kW @ Govt. Arts College,
Sector 20**

Installation on J.M. Bhavan



Key Takeaways

- Availability of rooftop inventory based on reliable, scientific & accurate rooftop survey
- Utility Buy in & Capacity building of utility staff for rolling out the projects
- Attractive feed-in-tariffs till grid parity is achieved
- Ground mounted systems and roof mounted systems need different policies
- Robust payment security mechanism for investors (letter of credit, Escrow, reliable credit ratings etc)
- For scale up Access to finance is key: Need to design appropriate financing schemes targeting individual rooftop owners as the sector grows

Phases in rooftop market development

Key focus on implementation of demonstration projects in Gujarat to:

- **showcase technical and financial feasibility of rooftop solar PV projects.**
- **provide insights to policy makers to envisage implementation models and capacity targets.**
- **reveal implementation issues to move market towards self-replication phase.**

Proof of Concept Phase

Market Transformation Phase

Mature Self-Replication Phase

- **Market transformation - bridge between proof of concept and mature self-replicating phase**
Focus of the phase to build capacity in market
- **Government or public agencies play an active role as market facilitator.**

- **Markets in self replication & self sustaining phase (e.g. Japan and Germany).**
- **New implementation models emerge which drive the market towards greater efficiency**
- **Government inputs are minimal with focus on providing a facilitating regulatory environment**

Replication in Gujarat & Other initiatives

- Replication Project (5 Cities) scope encompasses:
 - Installation of distributed rooftop solar photovoltaic systems in 5 cities: Baroda, Rajkot, Mehsana, Bhavnagar and Surat
 - 3 Packages totaling to 25 MW
 - Baroda (5) & Mehsana (5), Rajkot (6.5) & Bhavnagar (3.5), Surat (5)

Further demonstrate and scale up projects based on Gross metering model

- Encourage a shift to significantly greater use of private rooftops (relative to Gandhinagar pilot project where 80% of buildings were government/public owned)
- Bids received & under evaluation (awards expected by June)
- Working with GoG for
- Development of Solar Rooftop Policy for Gujarat
- Publication - A Primer to analyze relevant issues, disseminate knowledge, and serve as an analytical input to policy-makers (mainly based on Gandhinagar project)

Advisory engagement with regulator

- Draft guidelines on energy accounting, recommended commercial arrangements and tariff determination for rooftop grid connected solar photovoltaic projects
- Energy Accounting - metering and energy accounting related issues, agencies responsible and their roles for meter reading, billing and energy accounting
- Commercial Arrangements - Detailed assessment of possible options like: preferential tariff, net metering, renewable energy certificate etc.
- Key regulatory issues that may impact the implementation and operation
- Preparation of model PPA
- Tariff Guidelines
- Commission would frame Regulations for RE Solar Grid Interactive Systems under net metering, based on the model guidelines/regulations recommended
- Draft state level regulations published by state regulatory commissions Eg - DERC (Delhi)

Orissa - Bhubaneshwar and Cuttak Rooftop solar Project

Project Background

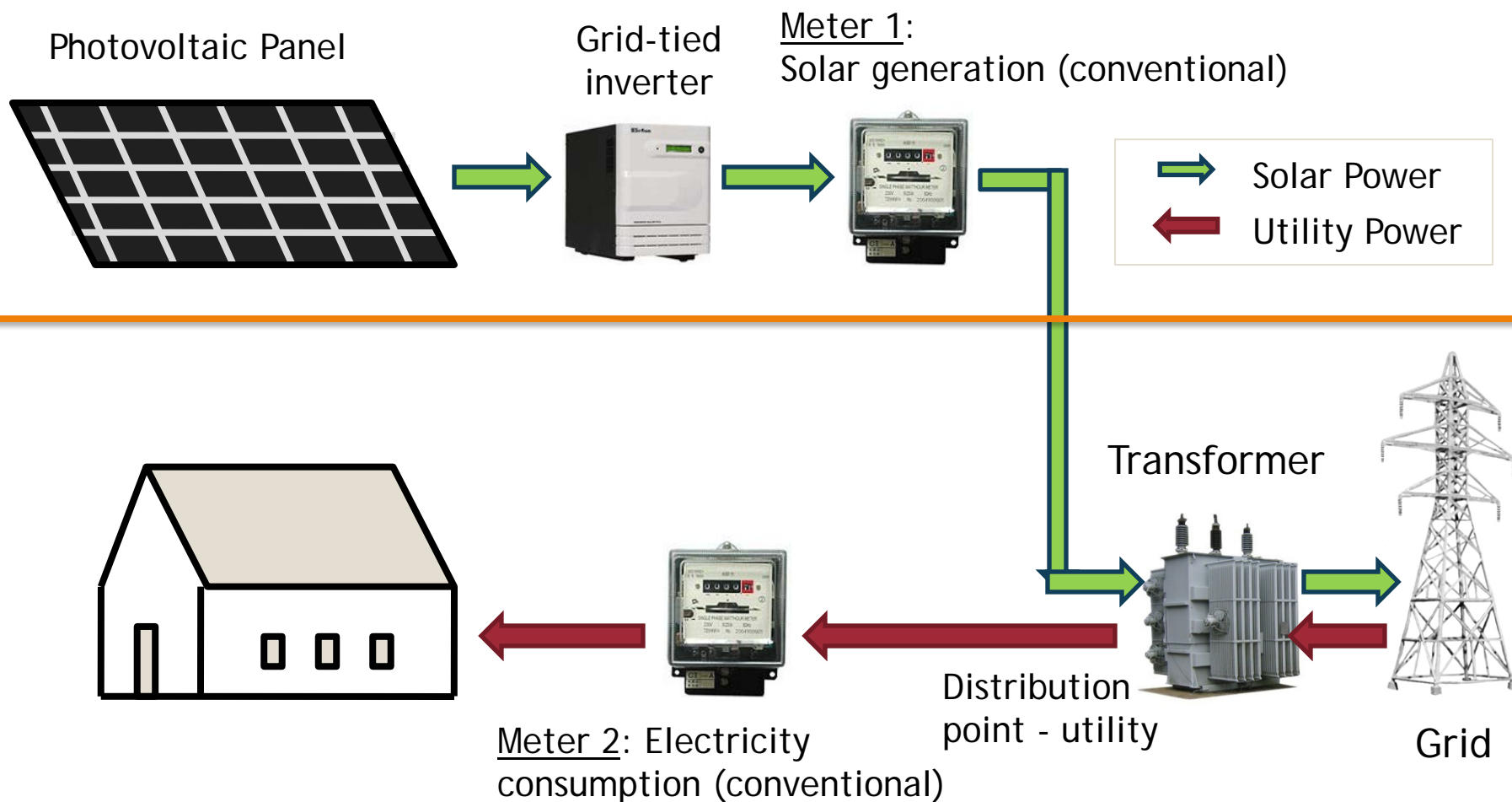
- ▶ As a part of the Odisha Renewable Energy Development Agency's (OREDA) vision and action plan 2012-13, OREDA intends to increase the mix of renewable energy to 10% of total power generation by 2020 in Odisha
- ▶ The Government of Odisha (GOO), with a view to developing a market for rooftop solar projects and with the larger objective of promoting solar energy development in the state, intends to develop a pilot and replicable grid connected rooftop solar project(s) on a public private partnership (PPP) basis in the cities of Cuttack and Bhubaneswar (the Project)
- ▶ GEDCOL is the principal agency designated by the GOO for executing the Project

Objectives

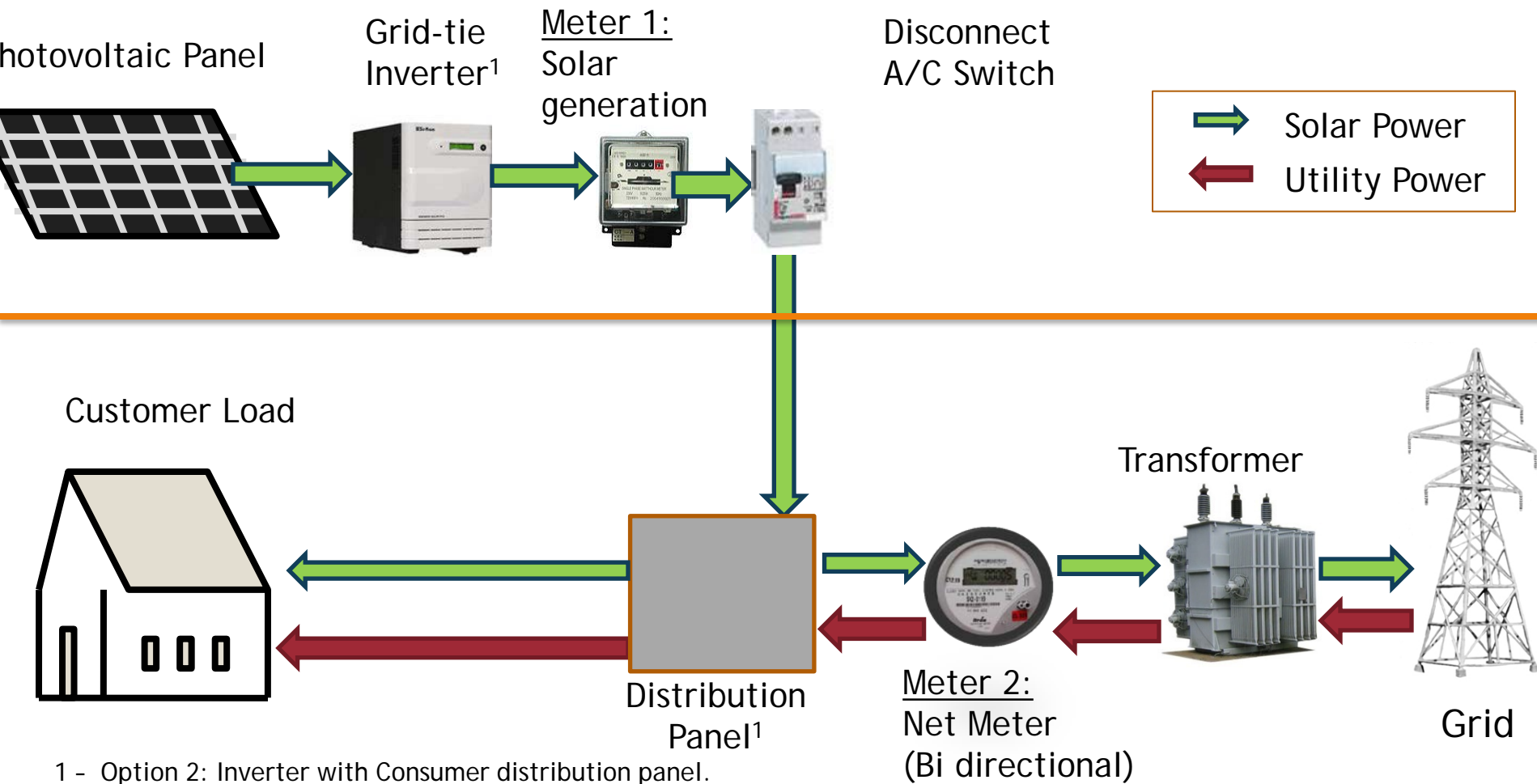
- Implement a pilot and replicable grid connected rooftop solar project in the cities of Bhubaneswar and Cuttack
- Development of technical, commercial and regulatory pre-requisites,
- Pave way forward to kick-start the market for rooftop solar projects in Odisha
- Along with the the Project facilitate framing of policy and legal framework for larger distributed/solar program in the state

Back Up

Gross metering PV system



Net metering PV system



1 - Option 2: Inverter with Consumer distribution panel.

Key Points Under draft regulation

A. Net metering regulations – Permitting provisions	
Definition of net-metering	<ul style="list-style-type: none"> • Self owned/third party owned facilities
Define permitting capacity limits for Individual Projects	<ul style="list-style-type: none"> • Individual capacity • Maximum capacity eligible for net-metering
Define Electricity generation limits	<ul style="list-style-type: none"> • Sale to utility by net metered – charges
Level of overall/local grid penetration	<ul style="list-style-type: none"> • Impact on utility's system
B. Tariff Guidelines	
Tariff settlement framework	<ul style="list-style-type: none"> • Self consumption • Excess injection into the grid
Applicability of Other charges	<ul style="list-style-type: none"> • Open Access charges, CSS, wheeling charge, banking etc

Key Points Under draft regulation

C. Metering

Meter Specifications and Standards

- Availability of LT bi-directional meters
- Adequacy of existing standards.
- CEA defined standards

D. Energy Accounting

Meter data compilation

- Roles and responsibilities

Settlement Period

- Define the accounting period
- Carry forward energy
- Sale of energy to Discoms

E. Commercial Arrangements

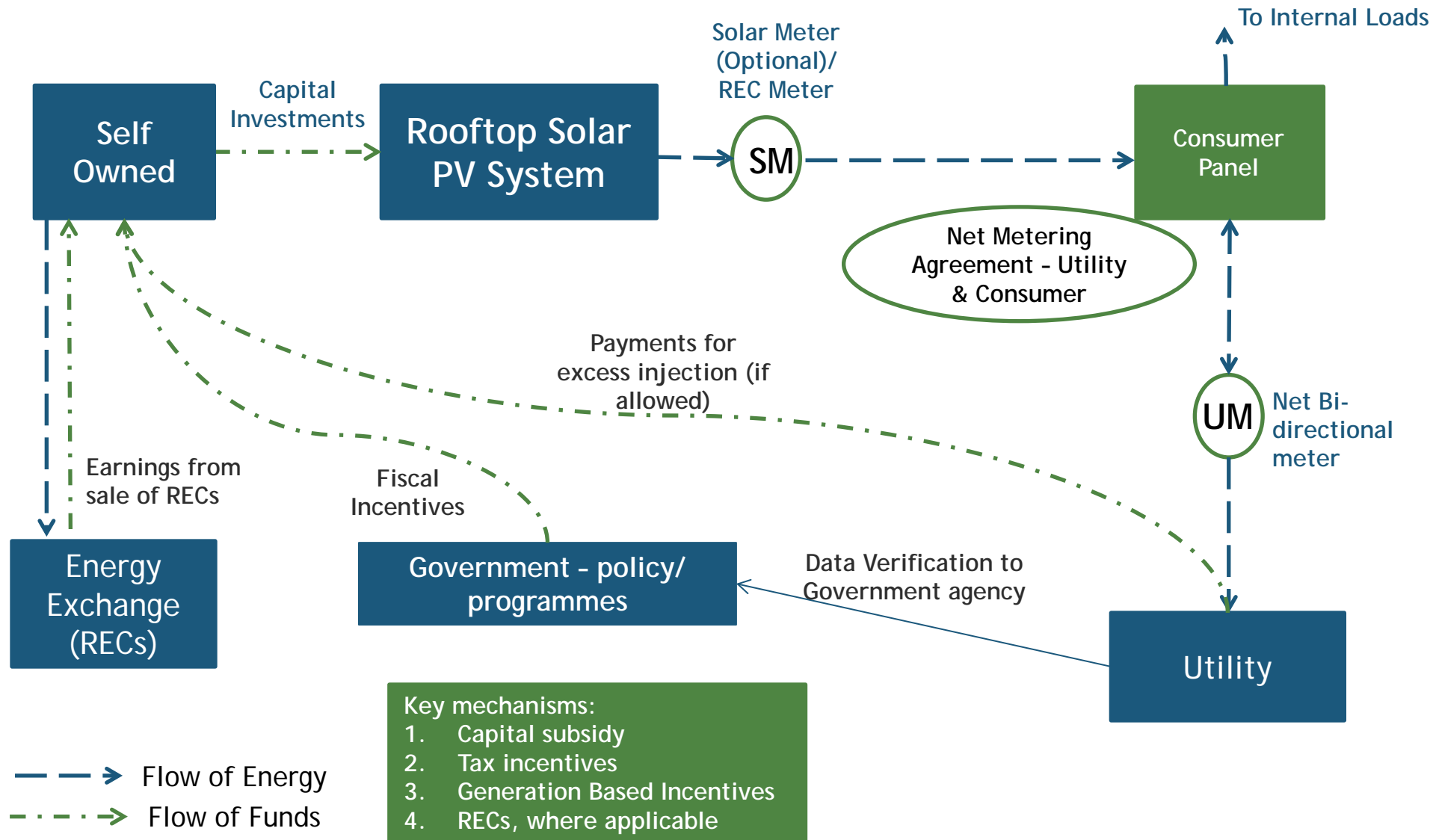
TOD Settlement

- Settlement to be in line with existing framework

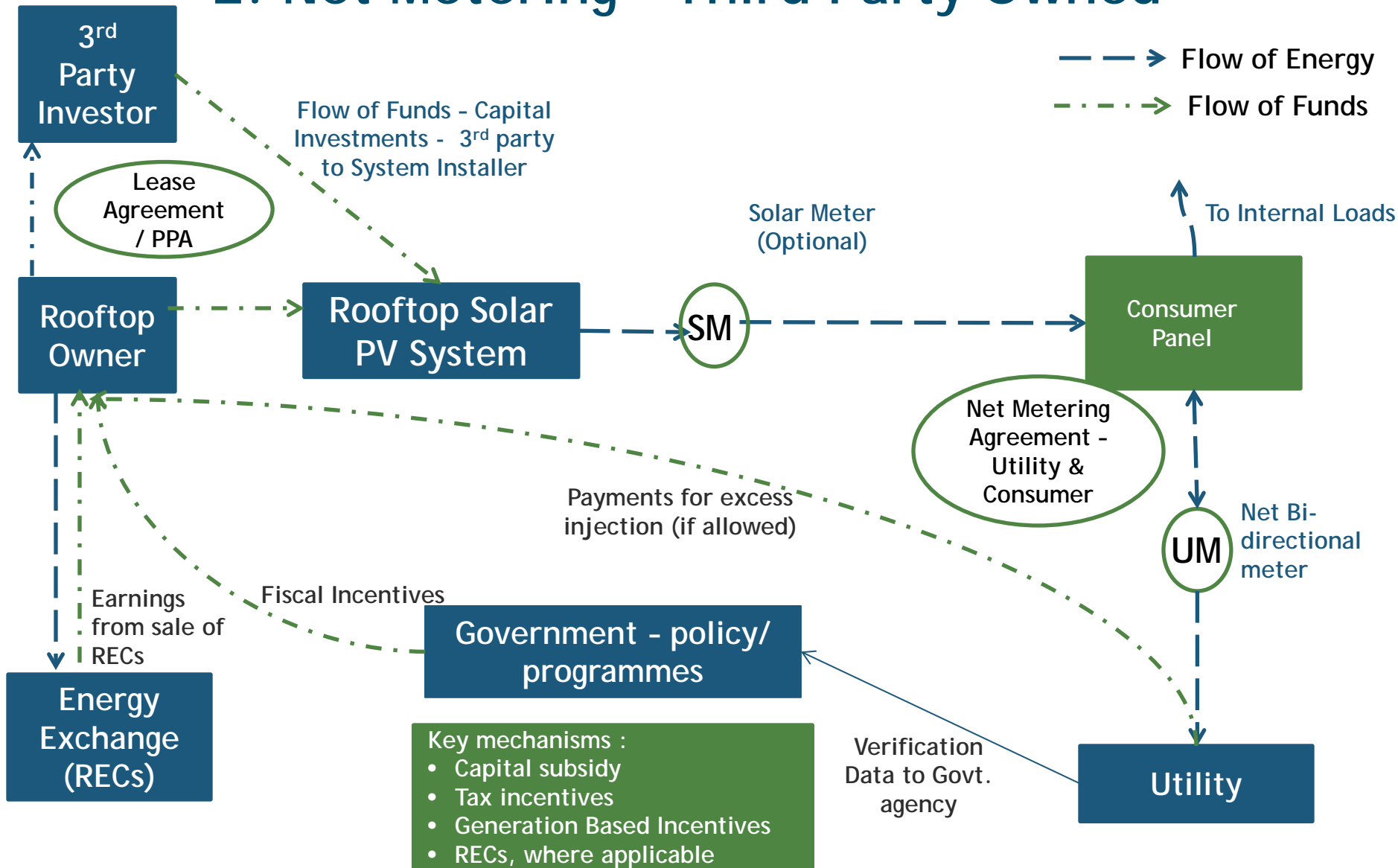
REC framework

- Changes in REC regulations for net metering

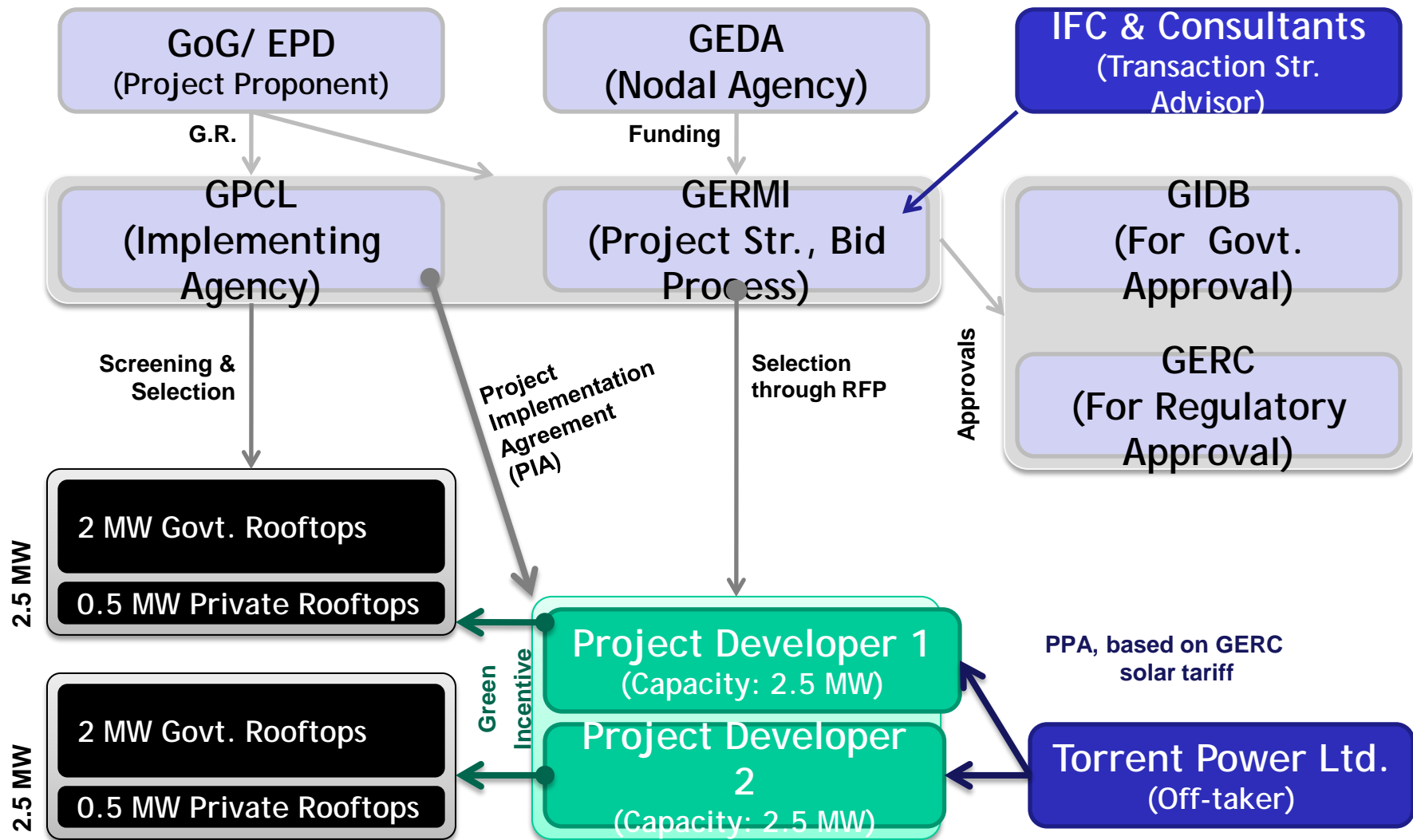
1. Net Metering - Self Owned



2. Net Metering - Third Party Owned



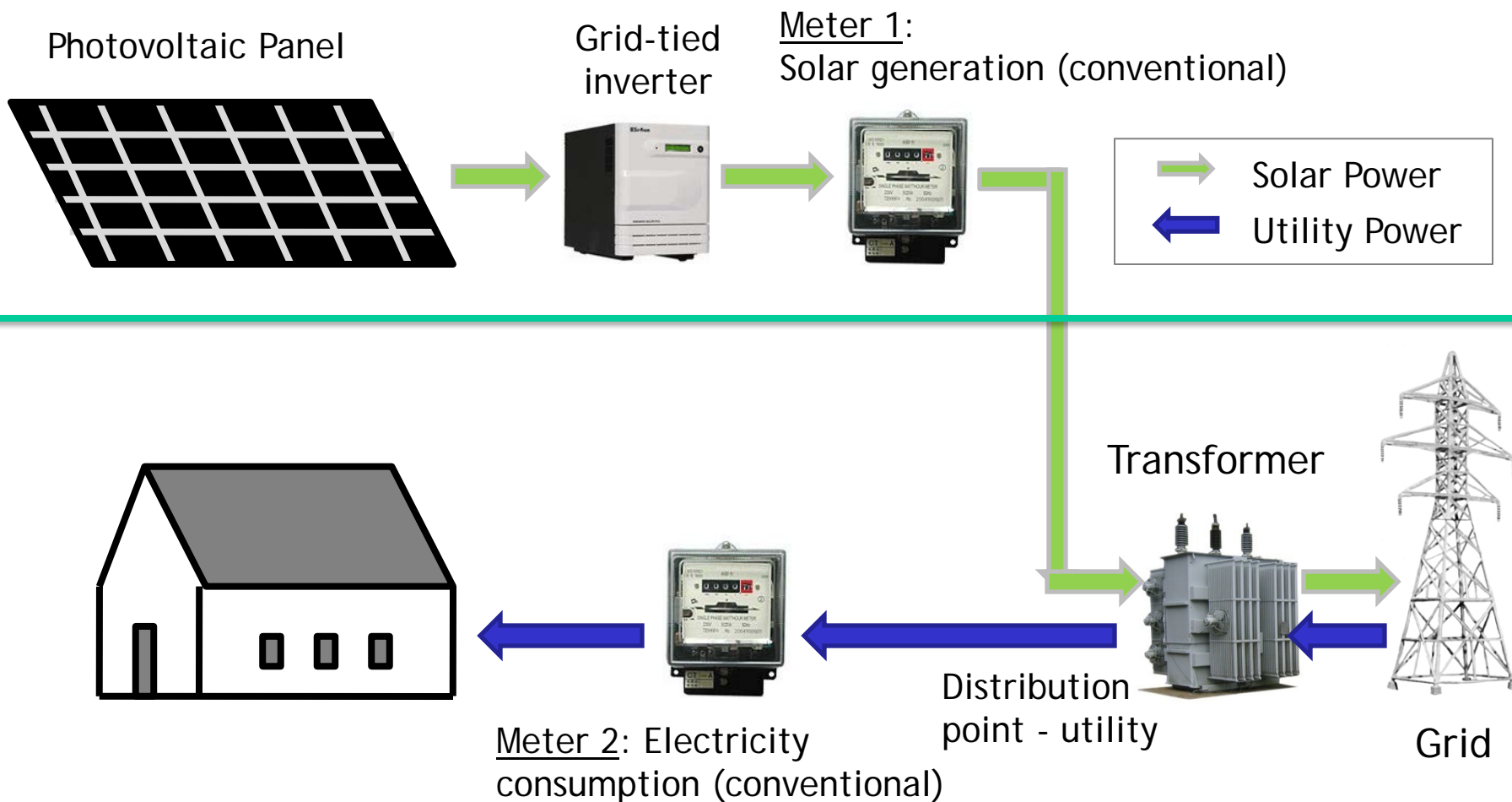
Transaction Structure among Stakeholders



Gross metering vs Net metering

Parameter	Gross Metering	Net-metering
Objective	<ul style="list-style-type: none"> Electricity sale to utility 	<ul style="list-style-type: none"> Self-consumption of electricity + sale of excess electricity to utility
Tariff Arrangement	<ul style="list-style-type: none"> PPA with the utility - utility to pay as per PPA price (FIT) 	<ul style="list-style-type: none"> Consumer to pay regulated consumer tariff for net electricity consumption from utility PPA between developer and utility for solar energy generated
Financial burden	<ul style="list-style-type: none"> Cost borne by utility & then passed through to the consumer 	<ul style="list-style-type: none"> Usually Govt. bears burden for any incentive/subsidy to bridge viability gap
Energy Accounting	<ul style="list-style-type: none"> Metering arrangement to measure generation only 	<ul style="list-style-type: none"> Metering arrangement to measure generation as well as sale of excess electricity to utility
Beneficiary	<ul style="list-style-type: none"> Assist utility in meeting Solar RPO compliance 	<ul style="list-style-type: none"> Assists consumer directly to reduce its electricity billing
Project Selection	<ul style="list-style-type: none"> Tariff based competitive bidding 	<ul style="list-style-type: none"> PPP based pilot project to facilitate large scale replication at later stages
Utility's Likely Concern	<ul style="list-style-type: none"> Higher FiT to be paid by Utility 	<ul style="list-style-type: none"> Loss of revenue for utility - reduced grid consumption by consumers Treatment of ToD
Developer's Concern	<ul style="list-style-type: none"> Grid unavailability to impact revenue 	<ul style="list-style-type: none"> Exposure to retail tariff variation in case of Capital Subsidy model ; GBI model preferable Grid unavailability also an issue

Gross metering PV system



Net metering PV system

